THE IMPACT OF COVID-19 ON SHIPPING INDUSTRY STUDYING ECONOMIC FACTORS

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Abstract

The aim of this paper is to analyse the impact of COVID-19 on shipping industry using a multiple-regression econometric model based on Ordinary Least Squares. The model has considered Valencia Containerised Freight Index as the dependent variable. Several exogenous variables will be included in the model to estimate their partial effect, ceteris paribus on the endogenous one, such as economic and maritime casuistry. Coronavirus, known as a global pandemic, had a strong impact on world economies during 2020.

As a result, this paper is focused on analysing COVID-19 impact on shipping industry. Therefore, it is going to be studied economic effects of pandemic for shipping companies in order to show how they managed this new scenario. As maritime transport represents 90% of global trade, this research wants to analyse why freight prices were constantly growing during months. Using quarterly cross-sectional database, we study three possible regressions, achieving an increase on goodness-of-fit statistic in each one. Despite of having a limited database, Spanish imports, Spanish E-commerce growth and Gross weight of goods handled in main Spanish ports have turned highly significant to explain rises on Valencian freight prices.

JEL Codes: **R40, R41**

Keywords: Blank sailing, Coronavirus, COVID-19, Disruption, Freight prices, maritime industry, Pandemic, PPE, Shipping, Supply Chain.

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1. Introduction

Since COVID-19 outbreak began in Wuhan, where first active cases were detected in December 2019, world countries have suffered strong impacts in their domestic economies, as well as, international flow of commodities have gone through worldwide logistic disruptions (Arican, et al., 2021; Gray, 2020). As China is the main global exporter of merchandises, coronavirus' spill over forced this nation, on the one hand, to paralyse manufacturing processes, which promoted factories' lockdowns and; on the other hand, boundaries closures, which were linked to the application of containment measures to affront the disease.

Maritime industry was totally affected by pandemic (Akyurek and Bolat, 2020; Dirksen-Fischer et al., Doumbia-Henry, 2020; Gray, 2020). Chinese ports were temporarily closed, managing minimum essential operations. In addition, COVID-19 outbreak matched with Lunar New Year, caused that port activities, terminal operations and land transport started to be congested. Global exports from China were paralysed and the rest of the world suffered a lack of supply of products, such as food and protective personal equipment. That is why, it is thought that pandemic has motivated a disruption of global supply chain (Arican, et al., 2021; Bryson, 2020). From shipping companies' perspective, they started to reroute their vessels, rescheduling ships, and therefore, delating port calls and raising transit times. This movement has been named as blank sailing (Fattal, 2021; van Tatenhove, 2021).

As a consequence, this disease started to be spread to the rest of the world, creating a cascade or domino effect. After China controlled COVID-19 spill over, maritime sector was reactivated. Nevertheless, the rest of the world started to find suspicious and active cases. The response of countries followed the same pattern as Chinese protocols: lockdowns of factories, mobility restrictions (it was only allowed the movement toward job positions) and total confinement to stop pandemic spill over. Regarding maritime sector, European and American ports started receiving inbound containers from China, however, shipping industry was totally locked and containers could not be returned to China (Akyurek and Bolat, 2020; Hoffmann et al., 2020; Notteboom et al., 2020; van Tatenhove, 2021; Arican et al., 2021).

At the beginning of the pandemic, America and Europe experienced a lack of inbound containers, which affected the reception of essential products to cover social needs. Currently, the situation is reverse. American and European ports are still congested and many containers are stuck at piles, waiting for being loaded and returned to China (Gray, 2020).

This situation has positioned shipping companies to an advantageous position, increasing

freight rates and controlling vessels' operating costs, such as bunkering. These economic aspects are going to be analysed in this paper, identifying which have been the main factors in order to reach current situation.

As a result, this paper is going to be focused on analysing COVID-19 impact on shipping industry. Therefore, it is going to be studied economic effects of pandemic for shipping companies in order to show how they managed this new scenario. The analysis will be based on Valencia Containerised Freight Index and economic factors that can explain freight prices' increase during 2020.

2. Theoretical framework

The purpose of this section is to specify the scope of the paper in order to define the main issues which are going to be analysed trough this investigation. As a result, this topic is going to introduce, in general terms, the main facts in which this paper is going to be based theoretically on. Moreover, it is included a literature review as a background information. This heading will collect an extract of already studied papers, following the same pattern of stylized facts and searching the compliance among them. This section will help the paper to be justified and reach its main objective.

Coronavirus (recently known as COVID-19) is a new infective illness generated by coronavirus family named as SARS-CoV-2 (WHO, 2020). This virus has also been defined as a "severe acute respiratory syndrome coronavirus 2" (van Tatenhove, 2021) due to its sharpest patient's clinical picture. The first case of coronavirus disease was identified in Wuhan, which is the capital of the province of Hubei, People's Republic of China (ICS[4], 2020). COVID-19 outbreak realised that overall governments, policymakers, global economy and society were not prepared to affront this worldwide health emergency.

In March 2021, global active COVID-19 cases were approximately 120.000.000 and coronavirus' world fatalities upgraded to 2.700.000 (Johns Hopkins University & Medicine[5], 2021). Since the first reported case, lack of preparedness, coordination and control among worldwide countries were key factors that aggravated this health crisis, generating community transmission (Doumbia-Henry, 2020; Strange, 2020). In fact, this illness not only affected social life (quarantine and containment measures are going to be explained hereafter), but also it had a general impact on global economy of countries, creating a domino effect (Arican, et al., 2021).

Uncertainty, caused by this disease, appeared in all sectors of national and global economies since the current entire world is strongly characterised by globalisation (Nekrasov and Sinitsyna, 2021). As the main objective of this paper is to analyse the impact of the pandemic in maritime industry, the effects are going to be described from logistics point of view. Bazaras (2021) explained this trade-off between global and domestic economies as: "the impact of the pandemic has been and is being felt in both global logistics supply chains and local markets". In this context of integrated globalisation between countries, world supply chain vulnerabilities have been shown due to this disease outbreak.

[4] International Chamber of Shipping (ICS, henceforth).

[5] Johns Hopkins University & Medicine, aligned with the Centre for Systems Science and Engineering (CSSE), located on Baltimore, Maryland, United States, is a COVID-19 resource centre in which high-skilled scientists and masters are involved in a constant daily-updating of global coronavirus cases and deaths.

Lack of resilience between global supply chain was the main result of pandemic outbreak, from business' perspective (Golan et al., 2020). They explained: "The COVID- 19 pandemic clearly shows the lack of resilience in supply chains and the impact that disruptions may have on a global network scale as individual supply chain connection". Systems of unsuccessful supply chains were detected, producing an integrated line of consecutives failures or cascade This extreme global dependency from Chinese exports boosted trade mismatches at the beginning of the pandemic, due to an excess of demand and scarcity of supply (Arican, et al., 2021).

In this context, since global COVID-19 outbreak arrived, the global shocks of demand were focused on using face masks, eyes protection, gloves, protective clothing, hygienizer and sanitizer hand gel to cover all worldwide population needs (ICS, 2020). Additionally, according to several harmful effects of COVID-19 on human bodies, each health-care institution, health organizations and hospitals needed ventilation devices and breathing machines to attend the most acute patient's diagnosis (Bazaras, 2021). Furthermore, PPE were strongly needed by healthcare personnel to not infect themselves (ADB, 2020; Golan et al., 2020; Strange, 2020).

According with a definition of resilience concept, National Academy of Science explains that resilience is "the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events" (National Research Council, 2012). Previous definition of resilience and knowing pandemic has affected each step of a supply chain, it is important to underscore a disruption of supply chain as a combination of an unintended and unexpected triggering event that occurs somewhere in the upstream supply chain (the supply network), the inbound logistics network, or the purchasing (sourcing) environment, and a consequential situation, which presents a serious threat to the normal course of business operations of the focal firm (Bode and MacDonald, 2017). These failures were mainly shown by food and personal protective equipment (PPE, afterwards) supply chains, because of existing problems in logistics and transportation systems (Gray, 2020).

The introduction of border closures across the world and mobility restrictions due to containment measures caused a huge gap of service in transportation and logistics sectors (Nwokedi et al., 2021). They were unable to attend an increasing demand shock of foodstuffs and medical supplies (Notteboom et al. 2020) as China is the main exporter of global products, quantified to 90% of global trade exports (Bryson, 2020).

"Medical supply chains are essential elements of a well-functioning health system" (ADB, 2020). Nevertheless, as it has already been said previously, the important flow of exporting

PPE so as 90% of mask fabrication comes from People's Republic of China, being at the same time the first country to impose locks on production and trade restrictions. They caused an important imbalance between imports and exports (Bryson, 2020)

Regarding the effects on maritime shipping industry, it is important to underscore the relevance of maritime traffic lines in international trade. Approximately 90% of international trade is carried out by maritime transport (Meng and Yuu Lee, 2015; Hoffmann et al., 2020; Lind et al., 2021; Mahpour et al., 2021). In this globalised context, ocean transportation has also been affected by pandemic, as well as, port activities.

According to Notteboom and Haralambides (2020), "a port is a place of contact between land and maritime space, a knot where ocean and inland transport lines meet and intertwine, an intermodal place of convergence. As such, port can also be defined as an area of land and sea, including designed installations to receive vessels, charge, discharge and store commodities. In addition, it allows the reception, dispatch merchandises and means of transport. It includes business activities related to trade and maritime activities (European Sea Ports Organization, 2010). That is why a port is an integrating and interconnected system of services, which guarantees an efficient logistic chain, including effective transportation routes and warehouses in which products can be stored.

Maritime transport was therefore influenced by pandemic outbreak. One of the most important impacts on shipping industry was the beginning of blank sailing movements (Fattal, 2021; van Tatenhove, 2021). Despite of having an increase in demand of food and medical tools, at early pandemic, maritime transportation was really affected by an extreme reduction of international trade (Gray, 2020).

The fact of having idle fleet[6] because huge vessels were not able to be fully loaded due to the existence of restrictions at ports, quarantine phases and global manufacturing shutdowns, produced a cascade effect of port calls' cutdowns and strategies to re-route regular vessels (UNCTAD, 2020). Shipping companies were forced to remove calls in seaports in order to manage their supply capacity and compensate the stability of freights[7], affecting containerized vessels as well as bulk carriers (van Tatenhove, 2021).

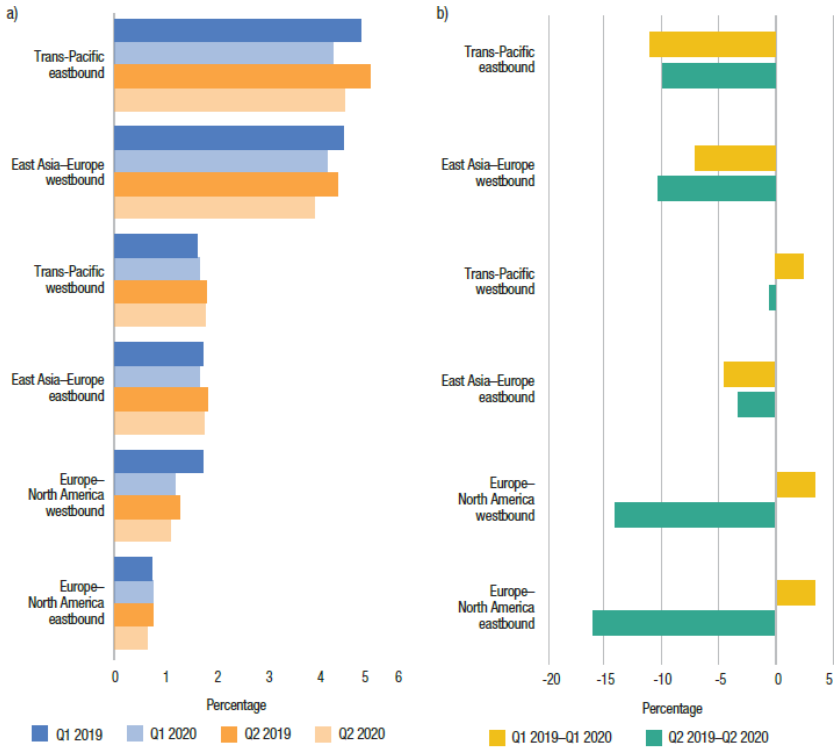
Economic effects on China were temporary due to the capacity of the country to control COVID-19 spill over across the nation. Consequently, common East-West maritime routes have suffered an unprecedent drop in their trade levels (UNCTAD, 2020).

[6] According to UNCTAD (2020): "11 per cent of the container fleet was estimated to be idle during the first half of 2020".

[7] Port calls' drop and reduction in bunker prices caused by the reduction of maritime loading's demand (additionally influenced by IMO 2020 new regulation) were two factors that helps to level freight rates.

It has been estimated a negative drop of 4.1% from maritime sector's perspective, compared to 2019. (UNCTAD, 2020). That is a slow-down has been highly found in containerized maritime traffic[8], above all in the first and second quarter of 2020, as it can be seen Figure 1.

Figure 1. Containerized trade growth on main East–West route. a) In million 20-foot equivalent units. b) Percentage change, first quarter 2019–first quarter 2020, second quarter 2019–second quarter 2020



Source: *UNCTAD 2020*

This negative environment in maritime sector has strongly affected another sector, which is very related to shipping industry: ports (Akyurek and Bolat, 2020; Dirksen-Fischer et al., Doumbia-Henry, 2020; Gray, 2020). Cancellation of port calls without pre-arrival noticed carried out by shipping companies caused several challenges in port areas, generating problems in their terminals, berths and yard activities (Roso et al., 2020). Furthermore, this fact has forced shippers and freight forwarders to paralyse inland activities and suspend

[8] Following Haralambides and Notteboom (2020), the growth of the most important container ports from January to June 2020, taking int account TEUs has been: "−6.8% in Shanghai, −1.1% in Singapore, −17.1% in LA, −6.9% in Long Beach, −7% in Rotterdam, +0.4% in Antwerp, −9.1% in Valencia, −20.5% in Barcelona and −29% in Le Havre".

bookings, creating supply chain disruptions (Fattal, 2021).

The establishment of containers as a new mode of transport in the sixties eased international flow of commodities among countries. It allowed the introduction of efficient supply chains, standardising port activities and logistic sector.

It also determined a reduction of loading and unloading time of vessels at ports and therefore, a cutdown in labour costs. One of the most important advantages of containerized traffic, apart from raising up efficiency, is that they were introduced as a stronger tool to protect exported and imported products in maritime market (Hoffmann et al. 2020).

Following the consequences of COVID-19 in maritime sector, there was an important problem based on imbalances in the number of containers at global ports, which is remaining nowadays, generating congestion, increasing number of stacked containers, delays in transit times and demurrages at ports of United States and Europe (Akyurek and Bolat, 2020; Hoffmann et al., 2020; UNCTAD, 2020; van Tatenhove, 2021; Arican et al., 2021).

Generally, inbound containers arrived at American and European ports in order to be unloaded. Then, those empty containers remained at ports until the moment to be fully loaded again in order to return to Asian ports (Gray, 2020). In normal conditions, there is a surplus of empty containers at imported ports (Notteboom et al., 2020). Nevertheless, COVID-19 outbreak in China aroused production shutdowns, restrictions and quarantine stages at ports, promoting supply chain's disruption and lockdowns in international trade. In this stage, import countries suffered the scarcity of needed products in supermarkets and hospitals due to lack of inbound containers (Notteboom et al, 2020).

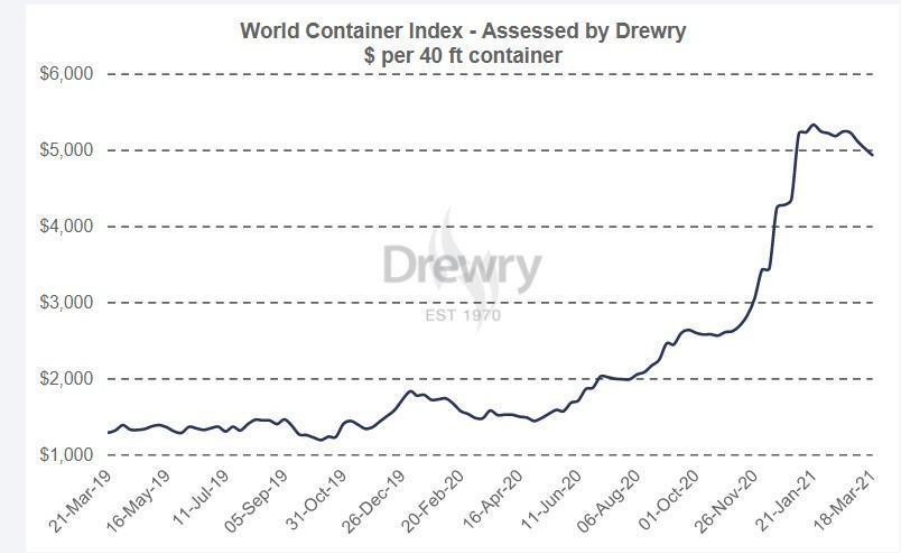
Blank sailings, schedules' changing and elimination of port calls began at Chinese ports (Chinese containerized traffic was reduced by 10,1% during January and February 2020, compared to 2019, according to Arican et. al., 2021). This problem at Chinese ports was exacerbated with the entry of New Chinese Year, creating a stronger atmosphere of uncertainty in shipping industry. In this way, there was a shortage of containers in import countries (UNCTAD, 2020). Consequently, coronavirus' spill over across world promoted the extension of lockdowns and restrictions affecting worldwide ports. The fact of imposing quarantine stages as containment measures in Europe and United States has implied to increase congestion and repositioning costs of idle containers at ports (Hoffmann et al. 2020) and the current lack of containers in Asia (Gray, 2020).

This Asian shortage of containers at ports has really impacted on freight rates due to its high demand (Arican et al, 2021). The industry of shipping, which is defined as: "volatile and risky sector, characterized by freight rate instability (Alarcón et al. 2020), can be explained according

two factors: the increasing gigantism of ships in order to achieve economies of scale (Nogué-Algueró, 2020) and the concentration of shipping companies to reach the maximum market share (Bottalico, 2021). Currently, the major players of maritime transportation are 2M, Ocean Alliance and THE Alliance (UNCTAD, 2020). This concentrated market has had an important consequence in freight rates during the pandemic, raising them up (Alarcón et al., 2020).

Implemented actions of shipping companies because of COVID-19 has helped to maintain strong prices (UNCTAD, 2020), and its bargaining power has been shown (Notteboom et al. 2020). In fact, following UNCTAD (2020): "In the first half of 2020, freight rates were higher compared with 2019 for most routes, with reported profits of many carriers exceeding 2019 levels." In this context, the lack of containers in Asia has pushed up freight prices. This result can be shown in this following graph, in which a 40' container could be freighted in approximately 1.200$ in March 2019. Two years later, the same container must be freighted in 5.000$ (see Figure 2).

Figure 2: World Container Index



Source: Drewry World Container Index (2021)

COVID-19 has come up as a global health emergency which have caused a worldwide strong collapse. The lack of global countries and authorities' preparedness to affront such a pandemic showed weak resilience between economic factors, resulted in global supply chain disruption.

As China is recognized as a main world exporter, COVID-19 outbreak in Wuhan paralysed this global flow. Chinese lockdowns, quarantine measures and manufacturing shutdown to contain

this virus had a negative impact on shipping industry, promoting delays at ports. This was the result of a lack of logistic personnel, scheduling changes, delays in transit times and blank sailings, carried out by shipping companies.

Consequently, maritime sector suffered an unprecedented increase of uncertainty. Additionally to these blockades, once Chinese production restarted its function again, there was a massive movement of outbound containers to the rest of the world. At this point, COVID-19 had already been extended across the globe. America and Europe implemented new measures to contain the disease, restricting mobility, applying quarantine phases and paralysing manufacturing.

Therefore, all outbound containers from China started to be stacked in inbound ports, creating congestion and an increase on time operations. The current lack of Asian containers, as well, has created an important economic issue for those who want to export and import merchandises. This is the main base of the severe raise on freight prices per TEUs or FEUs.

Concluded this section, the proposal of this paper is to analyse COVID-19 impact on shipping industry. This paper will be based on Mediterranean scope, focused on the activity of the one of the main ports of this sea, Valencia Port. Giving a more detailed and robust result, it is going to observe results for maritime route between Valencia and China ports. In order to achieve this goal, this investigation is going to be focused in one specific hypothesis, related to the general scope of the paper. As it has been mentioned previously, the main objective is to test economic effects of pandemic for shipping companies. It will be studied in detail, which factors have affected mostly the price given by shipping companies during 2020.

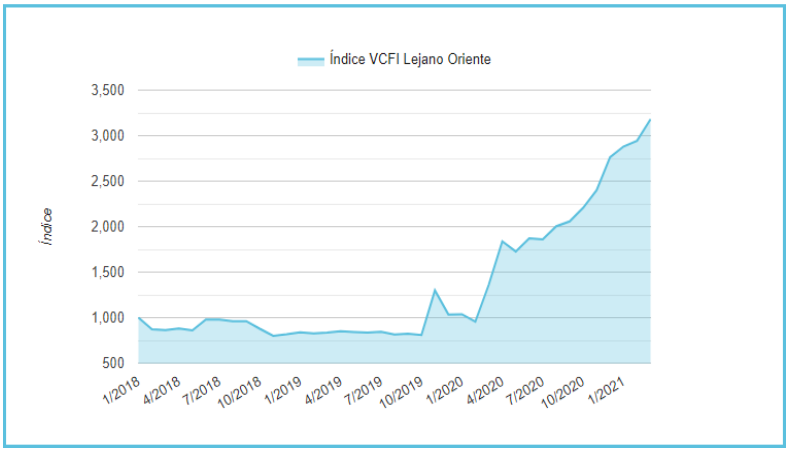
Understanding all literature review, it is going to be selected specific variables in order to test their impact on freight prices. In order to analyse them, it is going to be introduce an endogenous variable: Valencia Containerised Freight Index. This economic approach will help the investigation to identify which have been the main elements to explain blank sailings for example, and its increase on freight prices. Based on these results, it will be able to formulate an econometric model of multiple regression in order to analyse which factors can explain better COVID-19 impact on shipping industry economically.

3. Data and methodology

Following this section, it is going to be introduced data and methodology and therefore, the scientific approach for the paper. As it has been shown previously, the general hypothesis is the fact that pandemic has affected the price's structure of shipping companies. As a result, this investigation has chosen several variables in order to proof this general point. The justification of having chosen the following variables is based on author's knowledge, who after having been studying and analysing each criterion from literature review, it has decided these ones, considering its importance for the paper[9]:

As an endogenous variable, it will be used Valencia Containerised Freight Index (VCFI, henceforth). The importance of having chosen VCFI as a dependent variable is due this index represents the evolution of maritime freight prices for specific routes from Valencia Port to the rest of the world since 2018. The object of the study will be Valencia – Far East Route, which include main Chinese ports. Consequently, the reason, which justifies this paper, can be shown in Figure 3: it can be observed the uptrend of freight prices for 2020. Consequently, it is going to be studied the casuistic for this new scenario.

Figure 3: VCFI Far East

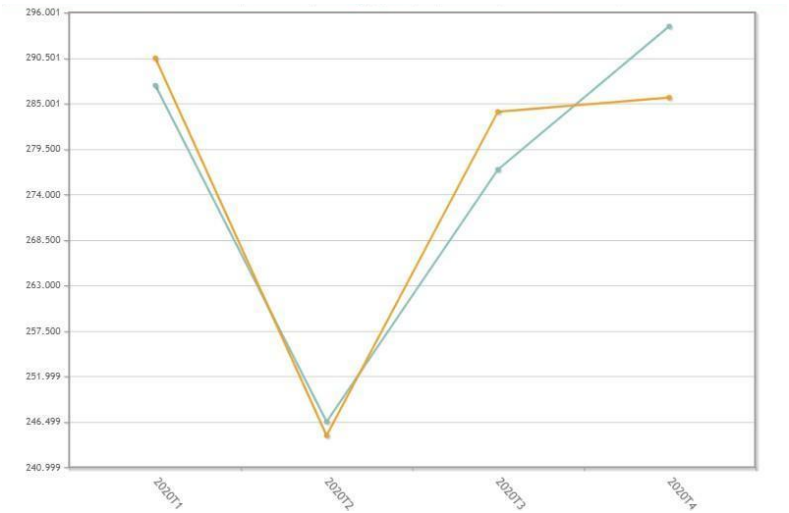


Source: Valenciaport

[9] Data source can be found in Annex 1: Descriptive output of variables

As an exogenous or independent variables, it will be used the following ones: Spanish Gross Domestic Product (GDP, henceforth) as a control variable. Figure 4 shows the strong decline of Spanish GDP because of coronavirus' outbreak.

Figure 4: Gross Domestic Product of Spain 2020

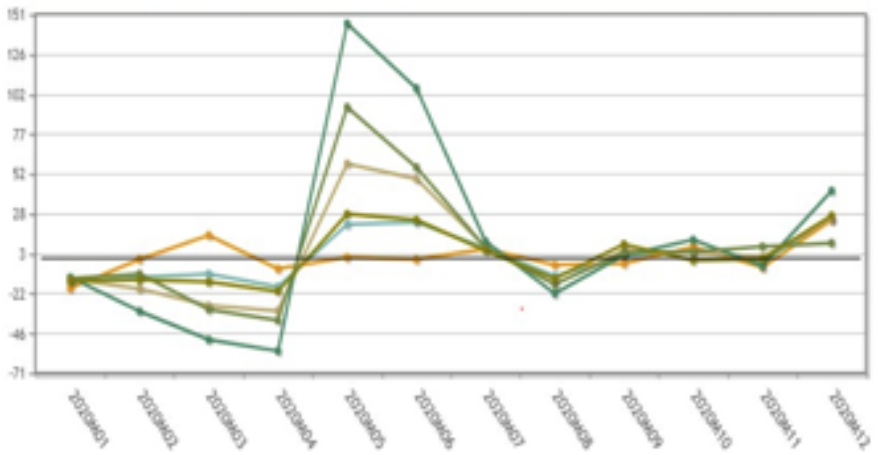


Source: *Statistics National Institute of Spain*

External demand given by Spanish exports and imports. One of the most expected negative effects of COVID-19 is a strong drop of external commerce. That is why, extern demand is going to be studied in this econometric model.

Spanish Retail Trade Index for 2020. This indicator will help the model to measure which have been prioritised products for domestic demand in Spain during this period of reference. Figure 5 shows variation rates for each product during 2020.

FIGURE 5: Spanish Retail Trade Index 2020



Source: *Spanish Statistics National Institute*

Being,

General

Food

Home Equipment

Rest

Personal Equipment

Other products

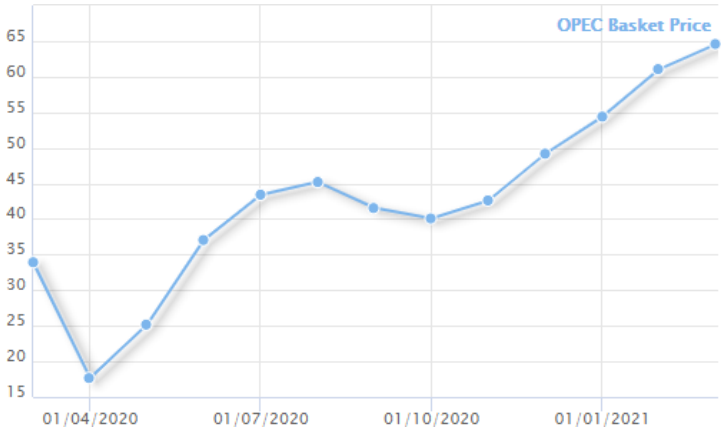
As it can be observed, one of the highest increases has been based on Personal and Home Equipment during second quarter of 2020, coinciding with Spanish house containment measures.

According with Sales Force Shopping Index, Spanish E-commerce growth for 2020. As social lockdowns were imposed nationally, E-commerce rates strongly raised. Online demand increased its importance for personal and home equipment, due to retail stores were closed. This fact also exacerbated port congestion and lack of inbound containers from China. Gross weight of goods handled in main Spanish ports will help to observe the quantity of products which were handled in national ports for import and export operations. This database will be extracted for Eurostat, which is “the statistical office of the European Union” (Eurostat, n. d).

Volume of transported containers to/from Spanish ports for 2020. This variable will play an important role in econometric model in order to explain blank sailings, delays in transit times and re-scheduling routes.

Figure 6 shows the evolution of fuel price for 2020 based on OPEC Reference Basket. The price of petroleum could explain variations of freight prices for this period of reference. The significant decrease on this market, subjected to new legislation from IMO 2020, in which vessels are forced to reduce sulphur until 0,5%.

Figure 6: OPEC Reference Basket 2020



Source: *Organization of the Petroleum Exporting Countries*

The main econometric model to test economic impact of coronavirus on VCFI will be based on a multiple cross-sectional regression, trying to find particular coronavirus' causes and effects on maritime business. Database is made by a sample of 8 observations, following a quarterly frequency from 2019Q1 until 2020Q4, according to data availability from main data sources. The statistical software, which has been used to estimate the model, is Stata.

Having introduced main variables of this paper, the general econometric model will be based on:

MODEL:

$$VCFI = \beta_0 + \beta_1 GDP + \beta_2 SX + \beta_3 SI + \beta_4 SRTI + \beta_5 SEG + \\ + \beta_6 SGW + \beta_7 SCV + \beta_8 OPEC + \mu$$

where,

GDP = Spanish Gross Domestic Product
SX = Spanish exports
SI = Spanish imports
SRTI = Spanish Retail Trade Index SEG = Spanish E-commerce growth
SGW = Gross weight of goods handled in main Spanish ports
SCV = Volume of containers transported to/from Spanish ports
OPEC = Fuel Price

As a result, the following Table 1 represents a complete summary of each variable that formed the general model:

Table 1: Statistical Descriptive of the Variables

Variable	Obs	Mean	Std Dev.	Min	Max
VCFI	8	1363.98	6.287.787	8.269.633	2456.37
GDP	8	295808.8	22580.34	245832	315833
SX	8	68908.06	6.722.092	55197.5	76394.8
SI	8	74583.27	9.054.408	55110	81642.9
SRTI	8	932.875	4.265.385	-43.17	107.4
SEG	8	30.375	2.630.012	9	75
SGW	8	119414.3	6.676.288	106950	126976
SCV	8	4004408	573026	3544093	5367366
OPEC	8	5.161.625	8 15.64099	22.97	70.18

Source: Elaborated by the authors

Secondly, this process will need to check and test which are the expected correlated signs between each exogenous variable and dependent variable. In order to process it, Stata will show Table 2, in which it can be observed matrix correlation among variables. Obviously, all variables get 100% linear correlation to themselves. However, Table 2 can compare variable's correlation by pairs in order to detect how much an independent variable is related to the dependent one.

Additionally, it has been added those variables which their correlated signs to VCFI are expected. This fact will help the investigation to specify an econometric model more accurately. Table 2 shows these expected signs.

Table 2: Expected correlation between pairs - variables

Endogenous Variable	Exogenous Variable	Sign
VCFI	SX/SI	+
	SRTI	+
	SEG	+
	SCV	+

Source: Elaborated by the authors

Consequently, these independent variables have shown how they can be proportionally correlated to the VCFI, as well as expected for econometric model. However, as this paper is going to be based on a multiple cross-sectional regression, Ordinary Least Squares (OLS) is the methodology, which this paper will use to specify econometric estimations and proof causality of VCFI. OLS method choses the estimated coefficients (β) of parameters, which minimise the sum of square residuals.

These coefficients will quantify the effects of exogenous variables on the dependent variable of the model, following ceteris paribus. Therefore, these coefficients will be able to justify and quantify VCFI variations:

RESIDUALS:

$$\hat{u} = -\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8$$

$$\hat{u} = VCFI_i - \beta_0 + \beta_1 GDP + \beta_2 SX + \beta_3 SI + \beta_4 SRTI + \beta_5 SEG + \beta_6 SGW + \beta_7 SCV + \beta_8 OPEC \text{ (adjusted)}$$

OLS:

$$min \sum_{i=1}^{n} \hat{u}^2 = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$

Before analysing general results of this econometric investigation, it is necessary to discuss some limitations of the model. Regarding the sample size, and considering coronavirus as a new fact to study since its beginning in 2020, this model will have a restricted database, with 8 observations for each variable of the model. It is expected that this econometric model is not highly affected by this limitation.

Nevertheless, it is important to consider this assumption. As the data only includes 2019 and 2020 trimesters, it is expected to detect in detail, which are the most important variables that can explain rises on Valencian maritime freights. Table 3 shows the correlation matrix.

***TABLE 3**: Correlation Matrix*

	VCFI	GDP	SX	SI	SRTI	SEG	SGW	SCV	OPEC
VCFI	1								
GDP	-0.6204	1							
SX	0.3762	0.8728	1						
SI	0.6010	0.9686	0.9345	1					
SRTI	0.3309	-0.8046	0.7340	0.8066	1				
SEG	0.8638	-0.8654	-0.6674	-0.8418	0.7401	1			
SGW	-0.6033	0.8847	0.8365	0.9170	-0.6281	-0.7111	1		
SCV	0.6420	0.0255	0.3475	0.1489	-0.2296	0.3560	0.1527	1	
OPEC	-0.7698	0.9391	0.7967	0.9072	-0.6289	-0.8653	0.9243	-0.1592	1

4. Results

Once data and methodology have been explained and considered general model, this section will present main results of estimations, which have been obtained from Stata in Table 4.

This decision rule (p-value approach) will be taken to obtain significant variables, according to following hypothesis for each β coefficient of the general model[10]:

- If p-value $\geq \alpha$: H_0 will not be rejected
- If p-value $\leq \alpha$: H_0 will be

rejected being,

$$\begin{cases} H_0\ (null\ hypothesis) \quad \beta_i = 0 \text{ (non-significant exogenous variable)} \\ H_1\ (alternative\ hypothesis) \quad \beta_i \neq 0 \text{ (significant exogenous variable)} \end{cases}$$

Having explained significance decision, Table 4 is going to present results for three possible scenarios:

[10] Error Type 1 shows significance level or the probability to reject null hypothesis when it is true in two-tailed contrast (Wooldridge, 2010)

***Table 4**: STATA main results*

Variables	MODEL 1 - VCFI	MODEL 2 - VCFI	MODEL 3 - VCFI
GDP	0.0022 (0.0065)		
SX		0.0309 (0.0122)	
SI			0.0958 (0.0353)
SRTI	9.6238* (2.5854)	8.5909* (1.5853)	
SEG	33.8507** (4.9697)	30.4566** (2.5270)	33.6846*** (6.9013)
SGW		0.0320 (0.0117)	0.08162** (0.03679)
Observations	8	8	8
Squared-R2	0.9575	0.9883	0.9909
(adjusted)	0.9257	0.9727	(0.9788)

Standard errors in parenthesis
p = 0.10* / 0.05** / 0.01***

Source: Elaborated by the authors

Table 4 shows three possible regressions, which can explain dependent variable (VCFI). Their specifications follow this pattern:

MODEL 1

$$VCFI = -230.854 + 0.0022GDP + 9.6238SRTI + 33.8507SEG + \hat{u}$$

$n = 8$ $R^2 = 0.9575$

This model has been formed by GDP, as a variable of control due to the expected impact of coronavirus has had on Spanish economy regarding consumption of families, investment of companies and public expenses. GDP has obtained a positive coefficient, which is subjected to

the partial effect on VCFI, ceteris paribus. Nevertheless, this variable has not shown significance in this estimation. On the other hand, Spanish Retail Trade Index, as well as Spanish E-Commerce growth has resulted in a strong impact on the dependent variable of the model. Therefore, these positive estimation signs agree to expected signs which have been placed previously. Coronavirus affected to consumption patterns, as social lockdown implied and increase on national sales (food in supermarkets and major surfaces, above all) and online sales (electronic devices, for example).

MODEL 2

$$VCFI = -212.315 + 0.0309SX + 8.5909SRTI + 30.4566SEG + 0.0320SWG + \hat{u}$$

$$n = 8 \; R^2 = 0.9883$$

Raising an improvement of the estimation and including more independent variables (which reduces the perturbation element and sub-specification problems of bias), the model has upgraded to an increase on R2 3.21% until 98.83% This fact has been based on including Spanish exports levels and the quantity of tones which has been moved in Spanish ports during 2019 and 2020. These variables allow the model to perform well- estimated coefficients, according to expected signs.

As much as Spanish exports were quantified, VCFI increases in order to balance demand- offer law and adjust freight prices to sellers. On the other hand, it is possible to find the same justification above gross weight tonnages due to an increase implies less availability of space at ports (more containerised traffic), higher pressure on labour force and flexibility of port and shipping companies' resources.

MODEL 3

$$VCFI = -514.601 + 0.0958SI + 8.5909SRTI + 33.6846SEG + 0.0816SWG + \hat{u}$$

$$n = 8 \; R^2 = 0.9909$$

Finally, Model 3 is the best estimation that this investigation has been able to find in order to explain VCFI. Removing Spanish exports from Model 2 and including Spanish imports in Model 3, R2 raises to 99.09%. This is an increase of 0.2%. The introduction of imports in the model is based on the fact that Spain, as the rest of the world, has performed a deficit position in international trade during COVID-19 crisis. As a result, as much as Spanish imports increases, VCFI also rises. This fact makes a completely sense since freight prices have been also affected by blank sailings, congestion and lack of equipment to transport commodities. As SRTI and SEG

improved continuously, Spanish imports went up, keeping pressure on maritime transport as well as capacity transport and freight prices.

According to the results, it is possible to confirm how Spanish Retail Trade Index[11] and Spanish E-Commerce growth have had a positive impact on freight prices due to Spanish imports increased exponentially during containment lockdown in second quarter 2020. In this way, the quantity of Spanish gross weight tonnes moved in ports achieved its importance, despite the fact of congestion and rescheduling vessel's routes.

On the other hand, analysing DATACOMEX database, it can be observed which types of products were imported by Spain during 2020. As it had been expected, Spain has been importing food resources to fulfil supermarkets and meet Spanish demand requirements as well as personal equipment such as technological devices bought form online platforms.

Nevertheless, it is important to highlight medical equipment which had to be quickly imported from China to cover Spanish hospitals and health care centre's necessities. Following graphs show those increases during 2020 for disinfectants and sterilization products (Figure 7), Oxygen therapy equipment (Figure 8), Medical devices and equipment (Figure 9), Protective garments (Figure 10), and COVID-19 Test kits and Instruments used in diagnostic testing (Figure 11).

[11] Model 1: SRTI (10%) and SEG (5%) / Model 2: SRTI (10%) and SEG (5%) / Model 3: SEG (1%).

Figure 7: Disinfectants and sterilization products.

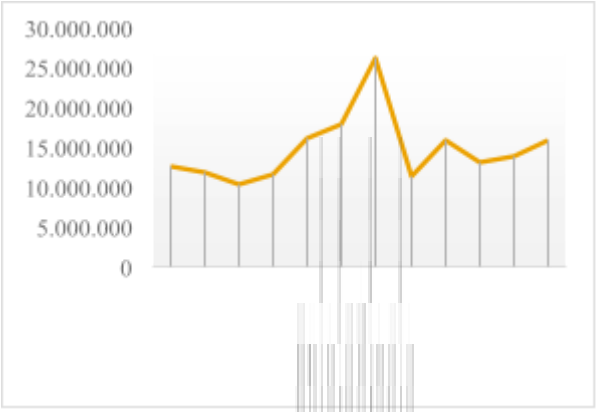


Figure 8: Oxygen therapy equipment

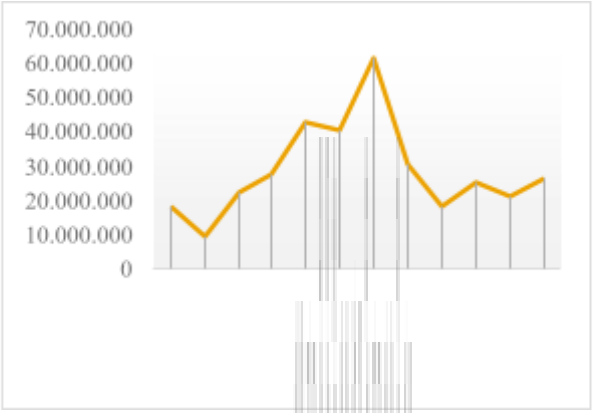


Figure 9: Medical devices and equipment

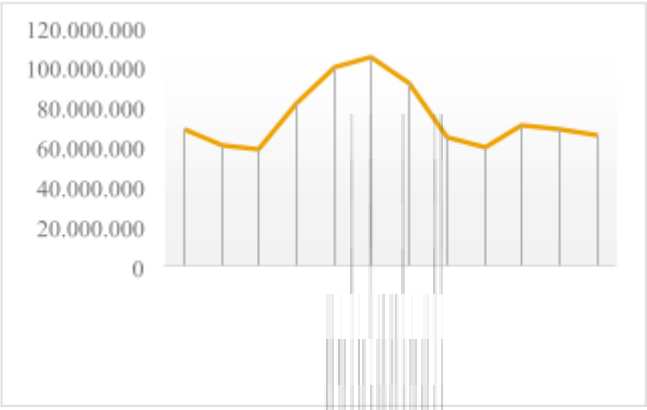


Figure 10: Protective garments

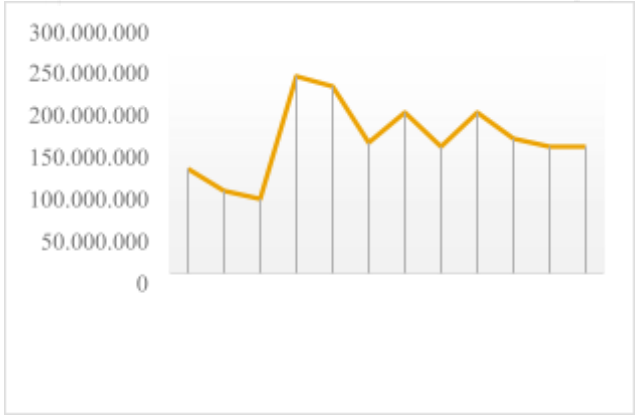
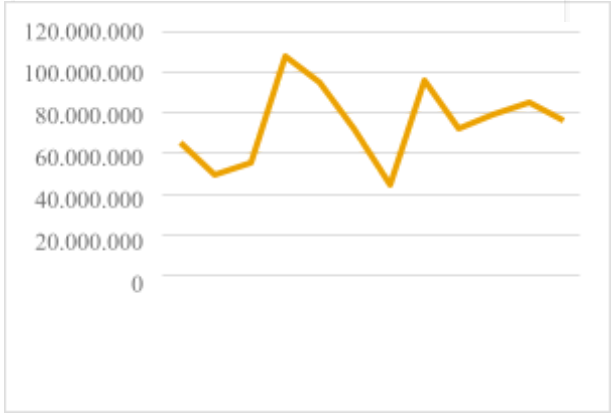


Figure 11: COVID-19 Test kits and Instruments used in diagnostic testing



Source: Elaborated by the authors

5. Conclusions

Coronavirus or commonly known as COVID-19 has been defined as a global illness which has had economic and social effects all over the world during 2020. First cases were detected in December 2019, in Wuhan, China. Consequently, strict measures were applied in China and had a domino effect on the rest of the world, as this country plays one of the most important positions in international trade.

Border closures, social lockdowns and production stoppages had a negative impact on maritime business due to outbound containers were stuck at Chinese ports and those vessels which had as a final destination China, they had to reschedule their transit times and cancel port calls. This movement has been named as blank sailing.

Rescheduling and delays in transit times had an impact on maritime freight prices with an unprecedented upward trend which currently continues. This fact has been aggravated by the lack of equipment in China to transport outbound containers and congestion at European and American ports to offload inbound containers. The result of this scenario is an imbalance on maritime trade which has caused a rise in freight rates.

The aim of this paper has been to analyse the impact of COVID-19 on freight prices, studying economic factors which could explain these increases. As a result, this paper purposes an econometric methodology based on a multiple cross-sectional regression, having Valencia Containerised Freight Index (VCFI) as a dependent variable. The model will study estimated coefficients which has a partial effect on this variable, ceteris paribus, applying OLS method.

Having estimated the general model by STATA, this investigation purposes three main models that can explain the relationship between independent variables and freight prices.

MODEL 1. It is based on Gross Domestic Product, Spanish Retail Trade Index and Spanish E-commerce growth. It shows the importance of national sales and Spanish online product imports during 2020. They have resulted significant to explain freight rates.

MODEL 2: It was removed GDP from previous model. It was added Spanish exports and gross weight of goods handled in main Spanish ports in order to observe Spanish trade compared to the rest of the world focusing on outbound containers. According to the estimations, as much as these variables represents a positive variation, VCFI rises.

MODEL 3: In spite of Spanish imports didn't become significant in the regression, this is going to be the purposed model according to general objective of the paper. Having studied the Spanish need to receive inbound containers of food, personal equipment and medical supplies, a positive coefficient means a partial increase on VCFI. This model also shows the importance

of Spanish E- commerce growth as well as the upward effect of gross weight managed at Spanish ports on dependent variable. This variable has taken into account congestion and containment measures at Spanish ports to manage the activity functionally.

For future investigations, it is purposed to use a wider database, including at least five years before and after pandemic to clearly see freight prices behaviour. In this context, an econometric regression based on differences between years will allow the model to predict better the impact on the dependent variable. On the other hand, this model could be used as base to estimate freight prices by time series. As it can bee seen, several approaches could be considered for following investigations. Therefore, as much data is used, econometric model will be closer to real effects.

Finally, this paper has tried to specify which has been the main economic factors that explains maritime freight prices. Furthermore, it has been possible to offer a general perspective of shipping companies' behaviour in maritime industry. They remained strong during pandemic stages since they achieved a strong position to negotiate prices, In fact, shipping companies continue being on a buoyant position thank to their marked economic power in front of commodities suppliers who want to transports their products by sea.

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7. Annex

7.1. Descriptive output of variables

Name	*Methodologic notes*
Valencia Containerised Freight Index (**VCFI**) Data source: Valenciaport Frequency: Quarterly	The aim of this index is to control freight prices' evolution of commodities in maritime transport from Valencia Port Authority. This will be used as a European reference for certain Mediterranean maritime routes and it has been created similarly to Shanghai Containerised Freight Index (SCFI). This measure reflects the evolution of market rates for outbound containers from Valencia Port to the rest of the world. This investigation will be focused on Maritime West- East route which includes main ports of China such as Singapur, Shanghai or Hong Kong. The composition of this index is powered by 12 companies[12] (shipping and freight forwarder's enterprises), offering their own rates. As a result, Valencia Port creates an average for each port including freight surcharges as Bunker Adjustment Factor (BAF), Currency Adjustment Factor (CAF) or Port Congestion Surcharge. These calculations are based on the following equation: $$tij \qquad f_j = \sum_{i=1}^{n} n$$ $$VCFI = \sum_{j=1}^{m} k_j * f_j$$ where, - f_j ☾ Rates of Port j on average - tij ☾ Rates offered by company i for Port j - n ☾ number of companies for Port j - k_j = weight factor for Port j - m = number of ports As per index, its period of reference is January 2018 (VCFI starting) with 1000 points (Valencia Port, n. d).

[12] Arkas, Cosco Shipping, Compagnie Tunisienne de Navigation (CTN), Grimaldi Lines, Mediterranean Shipping Company (MSC), Grupo Alonso, Grupo Raminatrans, Savino del Bene, TIBA, White Line Shipping, Deutsche Afrika- Linien (DAL) and K-Line are the members of VCFI (Valenciaport, n.d).

Name	***Methodologic notes***
Spanish Gross Domestic Product (**GDP**) Data source: Spanish Statistics National Institute Frequency: Quarterly	GDP is a macroeconomic magnitude, which can be defined as the sum of domestic consumption, companies' investment and Government budget (Feenstra and Taylor, 2011). This indicator will be used as a measure to study the economic value of Spanish production ordered by domestic demand during 2020. This magnitude is based on current prices for the analysed period, in millions of euros (Spanish Statistics National Institute, n. d).
External Demand (Spanish Exports and Imports) (**SX** and **SI**) Data source: DATACOMEX Frequency: Quarterly	The aim of these magnitudes is to mainly measure international trade of Spanish products for 2020. It is given by millions of Euros (Secretary of State for Trade, Industry and Tourism Agency, n. d).
Spanish Retail Trade Index (**SRTI**) Data source: Spanish Statistics National Institute Frequency: Quarterly	This measure tries to collect information from retail companies in order to control the evolution of market sector. This index is based on 2015 year's reference to analyse variations between two periods (Spanish Statistics National Institute. (n.d.). This index is classified by 6 groups of products: - General: Major (>25 stores and >50 employees) and Small (> 1 stores until 25 stores) Retail Chains and Superstores (> 2500m^2). It includes service stations. - Food Rest of products which include: Personal and Home Equipment and other products.

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Spanish E-commerce Growth 2020 (**SEG**) Data source: SalesForce Shopping Index Frequency: Quarterly	This index will analyse the e ffects of containments measures on domestic families' demand. This variation rate is based on Q1 2018 / Q2 2018 / Q3 2018 / Q4 2018 for 2019 and Q1 2019 / Q2 2019 / Q3 2019 / Q4 2019 for 2020.
Gross weight of goods handled in main Spanish ports (**SGW**) Data source: Eurostat Frequency: Quarterly	Measured by thousands of tonnes (EC, 2021).

Volume of containers transported to/from Spanish ports (**SCV**) Data source: Eurostat Frequency: Quarterly	This variable will include loaded and empty containers. However, this metric is only based on Twenty-Foot Equivalent Unit (TEUs) (EC, 2021).